

7N #64150

ISO 20088

STS 41-D National Space Transportation Systems Program Mission Report

September 1984

LIBRARY COPY
LIBRARY COPY

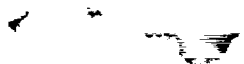
FEB 2 1985

LANGLEY RESEARCH CENTER
LIBRARY, NASA
HAMPTON, VIRGINIA



National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas



11

11

11

11

11

11

11

11

11

11

11

11

11

11

11

11

11

11

11

11

11

11

11

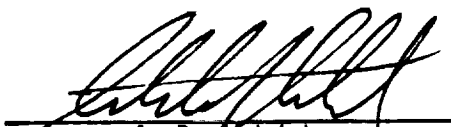
11

11

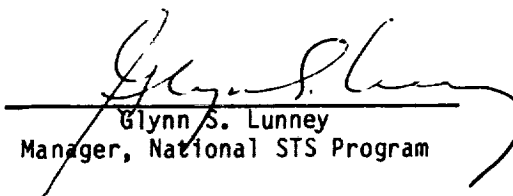
STS 41-D
NATIONAL SPACE TRANSPORTATION SYSTEMS PROGRAM
MISSION REPORT



Michael A. Collins, Jr.
Manager, Shuttle Data
and Evaluation Office



A. D. Mdrich
Manager, Space Shuttle Projects



Glynn S. Lunney
Manager, National STS Program

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS 77058

September 1984

THE UNIVERSITY OF CHICAGO
LIBRARY
1100 EAST 58TH STREET
CHICAGO, ILL. 60637

TABLE OF CONTENTS

<u>Title</u>	<u>Page</u>
<u>INTRODUCTION AND MISSION OBJECTIVES</u>	1
<u>MISSION SUMMARY</u>	1
<u>VEHICLE ASSESSMENT</u>	5
<u>SOLID ROCKET BOOSTER</u>	5
<u>EXTERNAL TANK</u>	5
<u>SPACE SHUTTLE MAIN ENGINE</u>	5
<u>MAIN PROPULSION SYSTEM</u>	5
<u>ORBITER</u>	6
<u>CRT-2 Went Blank</u>	6
<u>Supply/Waste Water Nozzle Iced</u>	6
<u>Oxygen Leak</u>	6
<u>Fuel Cell 1 Performance Monitor Indicator Failed</u>	7
<u>Microswitch Anomalies</u>	7
<u>Vehicle Pulled to Right After Nose Gear Touchdown</u>	7
<u>PAYLOAD AND EXPERIMENTS</u>	7
<u>SBS-D SATELLITE</u>	7
<u>SYNCOM SATELLITE</u>	8
<u>TELSTAR 3-C SATELLITE</u>	8
<u>SOLAR ARRAY EXPERIMENT</u>	8
<u>CONTINUOUS FLOW ELECTROPHORESIS SYSTEM</u>	8
<u>IMAX 70MM CAMERA</u>	8
<u>RADIATION MONITORING EQUIPMENT</u>	9
<u>CLOUD PHOTOGRAPHY</u>	9
<u>STUDENT EXPERIMENT</u>	9

INTRODUCTION AND MISSION OBJECTIVES

The STS 41-D National Space Transportation Systems Program Mission Report contains a summary of the major activities and accomplishments of the twelfth Space Shuttle flight and the first flight of the OV-103 vehicle, Discovery. This report also summarizes the significant problems that occurred during the STS 41-D launch scrub and launch abort, as well as the mission. The problem tracking list is presented to provide a complete list of all Orbiter problems that occurred. Four of the problems are of concern to the STS 41-G mission, and these are discussed in the latter portion of the report.

The primary objectives of the STS 41-D mission were the deployment of the SYNCUM-IV, Telstar 3-C, and SBS-D satellites; operation of the OAST-1 (Office of Aeronautics and Space Technology-1) payload; and accomplishment of the functions of the Radiation Monitoring Equipment (RME), the Continuous Flow Electrophoresis System (CFES III), and the IMAX Camera. The sequence of events for this mission are shown in table 1. The problem tracking lists for the MSFC (Marshall Space Flight Center) elements and the Orbiter are shown in tables II and III, respectively, at the end of the report.

MISSION SUMMARY

The STS 41-D mission, the first for the OV-103 vehicle, Discovery, was scheduled for launch on June 25, 1984, and June 26, 1984, and August 29, 1984. The attempted launch on June 25, 1984, was scrubbed because GPC-5 (general purpose computer-5), which contained the backup flight system software, exhibited two memory parity errors at T-32 minutes. At T-20 minutes, the launch was scrubbed because the problem, which was subsequently diagnosed as contamination of an integrated circuit, could not be corrected without hardware removal and replacement.

The launch was rescheduled for June 26, 1984, and all aspects of the countdown were nominal until T-4 seconds when irregular operation of the main fuel valve on SSME-3 (Space Shuttle main engine 3) resulted in an engine shutdown (abort) condition. The MSFC report entitled, STS 41-D (14) Launch Attempt Report, dated July 3, 1984, contains a more detailed discussion of the launch abort. As a result of the abort, the decision was made to roll the vehicle back to the VAB (Vertical Assembly Building) and remanifest the mission, combining the payloads from STS 41-F with STS 41-D. A new launch date of August 29, 1984, was established. However, the launch was delayed for 24 hours because of a timing problem between the flight software and the MEC (master events controller). Tests showed that under certain worst case timing conditions, the MEC would not process certain critical events commands and, as a result, could prevent separation of the SRB's and ET as well as other vital operations. A software patch was developed, tested, and incorporated in the vehicle computer software to work around the timing problem, and allow the launch to proceed on August 30, 1984.

The final countdown again proceeded very smoothly for the planned launch at 8:35 a.m.e.d.t. However, the launch was delayed 6 minutes and 50 seconds at T-9 minutes because of a problem with the ground launch sequencer and two private aircraft that were flying in the restricted area for launch operations. Lift-off occurred at 243:12:41:50 G.m.t. from Launch Complex 39A at KSC (Kennedy Space Center) on August 30, 1984, and the mission was successfully concluded with a landing at Edwards AFB (Air Force Base), at 249:13:37:54 G.m.t. on September 5, 1984.

The crew for this flight was Henry W. Hartsfield, Jr., Commander; Michael L. Coats, Cdr, U.S. Navy, Pilot; Dr. Steven A. Hawley, Richard M. Mullane, Lt. Col. USAF, and Dr. Judith A. Resnik, Mission Specialists; and Charles D. Walker, Payload Specialist.

The ascent phase was normal in all respects. The SRB (solid rocket booster) head pressures and burn rates were normal with SRB separation occurring within 0.14 second of the predicted. Main propulsion system and engine performance were as predicted with all thrust values indicating repeatable performance. MECO (main engine cut off) occurred 0.3 second earlier than predicted. The orbital parameters at MECO were as predicted. The OMS (orbital maneuvering system) burns, -1 and -2, placed the vehicle in a near circular orbit at 160 nautical miles.

The first day of STS 41-D mission was very successful. The deployment of the SBS satellite was completed very smoothly and the 87-second firing of the PAM (payload assist module) motor was completed satisfactorily. The failures that occurred the first day were minor and had no impact on the flight. The most significant failures were that CRT(cathode ray tube)-2 went blank and the fuel cell 1 CPM (cell performance monitor) ceased operating. The IFM (inflight maintenance) procedure for placing CRT-4 in the CRT-2 position was performed on the fourth day. As a result of the fuel cell 1 performance monitor failure, main bus A and B were tied together during on-orbit operations so that fuel cell 1 and 2 performance could be compared.

The second day of the STS 41-D mission was satisfactory with no new Orbiter anomalies defined during the period. Payload deployment activities were nominal. The SYNCOM satellite was successfully deployed using a technique referred to as a "frisbee deploy". Also, SYNCOM was the first satellite specifically designed to fly on Space Shuttle. All planned testing for the second day was satisfactorily completed.

The third day of the STS 41-D mission proceeded very smoothly with no new Orbiter anomalies or problems defined during this period. All Orbiter subsystems continued to operate satisfactorily. Deployment of the third satellite, Telstar, as well as its perigee burn, were completed very satisfactorily. Postflight reports of the three deployed satellites indicate all three are on station in the desired geosynchronous orbit. The OAST/Solar Array Experiment operations were successful with the array deployed to 70 percent for dynamic tests.

The fourth day of the STS 41-D was completed successfully. All planned payload activities were accomplished and damping tests of the 100-percent deployed solar array produced better than predicted results, thus allowing shopping list items to be accomplished in addition to the planned items.

As a result of the data review of the supply water dump at approximately 68 hours MET (mission elapsed time), it was determined that ice had formed around the supply dump nozzle. There also were indications that ice had formed around the waste water dump nozzle, but it was believed that the ice did not remain. The RMS (remote manipulator system) was deployed and the RMS TV showed a large column of ice over the supply nozzle. A waste dump was attempted with TV coverage; ice buildup was observed and the waste dump was terminated.

The fifth day of the STS 41-D mission was completed with all Orbiter subsystems and experiment systems operating satisfactorily, but a major concern existed over the ice formation on the supply and waste dump nozzles. A TV scan showed that the amount of ice was considerably less than the amount observed about 24 hours earlier. Primary RCS (reaction control system) firings were performed in an unsuccessful attempt to dislodge the ice. The cabin was depressurized to 10.2 psia to provide for a potential contingency EVA (extravehicular activity) in the event the RMS operation was unsuccessful in removing the ice. Subsequently, early on the sixth day, the RMS was used to remove the ice from the supply dump nozzle, but the ice still remained on the waste dump nozzle. The cabin was repressurized to 14.7 psia. A subsequent TV survey of the dump nozzles after extended sun exposure and repeated nozzle heater cycles showed that the remaining ice was essentially gone.

All planned OAST-1 activities were completed and the solar array was retracted and, locked down. The crew completed the flight control system checkout using APU-2 (auxiliary power unit) satisfactorily. Final activities with the CFES (continuous flow electrophoresis system) were ended just prior to the final sleep period with 85 percent of the samples processed.

The crew was awakened early on entry day because of an oxygen leak (about 30 pound/hour) in the environmental control and life support system. The crew performed the necessary malfunction procedures and were able to isolate the leak and stop the flow of oxygen to that point. This leak did not impact the entry day activities, but did cause the loss of redundancy in that system.

The crew completed all activities required for entry and performed the deorbit maneuver at 249:12:36:20.2 G.m.t. The entry was normal and all PTI (programmed test input) maneuvers were performed. After completing the HAC (heading alignment circle) turn angle of 251 degrees, the Orbiter was guided to a landing at Edwards AFB. Rollout required approximately 10,270 feet. An inspection after landing revealed the right main gear strut had lost its pressure, a condition that caused the Orbiter to pull to the right after nose gear touchdown. The STS 41-D mission was successfully concluded at 249:13:38:54 G.m.t., when the Orbiter came to a stop on lakebed runway EDW17L. All 15 of the planned detailed test objectives had been successfully accomplished.

TABLE I. - STS 41-D SEQUENCE OF EVENTS

Event	Actual time, G.m.t.
APU activation (1)	243:12:36:58
(2)	243:12:36:59
(3)	243:12:37:00
SRB HPU Activation command LH-A2	243:12:41:22.29
MPS start command sequence (engine 3)	243:12:41:43.43
SRB ignition command from GPC (lift-off)	243:12:41:50
MPS throttle down to 84-percent thrust (engine 3)	243:12:42:09.14
MPS throttle down to 65-percent thrust (engine 3)	243:12:42:20.02
Maximum dynamic pressure	243:12:42:40
MPS throttle up to 104-percent thrust (engine 3)	243:12:42:57.62
SRB separation command	243:12:43:54.5
MPS throttle down for 3g acceleration (engine 3)	243:12:49:28.80
Main engine cut off (MECO)	243:12:50:25.2
External tank separation	243:12:50:43.8
OMS-1 ignition	243:12:52:25.5
OMS-1 cutoff	243:12:54:59.1
APU deactivation (1)	243:12:56:10
(2)	243:12:56:11
(3)	243:12:56:12
OMS-2 ignition	243:13:26:39.7
OMS-2 cutoff	243:13:28:45.9
SBS-D deploy	243:20:40:18
OMS-3 ignition	243:20:55:18
OMS-3 cutoff	243:20:55:31
SYNCOM IV deploy	244:13:16:27
OMS-4 ignition	244:13:31:26
OMS-4 cutoff	244:13:31:35
TELSTAR 3-C deploy	245:13:25:52
OMS-5 ignition	245:13:39:38
OMS-5 cutoff	245:13:39:50
OMS-6 ignition	245:15:13:25
OMS-6 cutoff	245:15:13:46
OPS-8 (flight control system) checkout APU 2 activation	248:11:41:45
APU 2 deactivation	248:11:45:00
APU 3 activation	249:12:31:22
Deorbit maneuver ignition	249:12:36:20.2
Deorbit maneuver cutoff	249:12:39:07.0
APU 1 activation	249:12:54:05
APU 2 activation	249:12:54:06
Entry interface (400,000 ft)	249:13:07:03
End blackout	249:13:26:33
Terminal Area Energy Management (TAEM)	249:13:31:19.3
Main landing gear contact (LH)	249:13:37:54
Nose landing gear contact	249:13:38:08
Wheels stop	249:13:38:54
APU deactivation complete	249:14:00:02

VEHICLE ASSESSMENT

SOLID ROCKET BOOSTER

All Solid Rocket Booster (SRB) systems performed as expected. The SRB prelaunch countdown was nominal with no problems noted. Performance of both SRM's was near predicted values and well within the allowed envelopes. Head pressures and propellant burn rates were as predicted. Thrust imbalance was within specification throughout SRB operation. Preliminary indications are that the SRB's separated approximately 0.14-second earlier than predicted.

The SRB recovery system operated nominally, with both SRB's reported to be floating in the normal manner approximately 2.4 miles apart. Reports from the recovery ships indicated that all main parachutes deployed. Both frustums were recovered, and also all parachutes were recovered and had only minimal damage.

EXTERNAL TANK

All External Tank (ET) systems performed as expected. No TPS (thermal protection system) anomalies were observed. Normal icing was reported in the waived areas, and no acreage ice was reported. The only problem reported was the continued failure of the two nose cone temperature sensors that had failed on the earlier launch attempts. This problem had no effect on ET performance. All ullage pressure transducers were in the normal operating band throughout prepressurization and the flight. After separation, the tumble was noted on tracking radars, and the impact was within the planned footprint.

SPACE SHUTTLE MAIN ENGINE

All SSME (Space Shuttle Main Engine) parameters appeared nominal during the prelaunch countdown and compared well with prelaunch parameters that were observed during the previous STS 41-D launch abort on June 26, 1984.

All valves functioned satisfactorily, meeting the newly adopted Launch Commit Criteria (LCC). Performance at start, mainstage, shutdown and propellant dump was satisfactory. The initial thrust buildup of main engine 3, although within specification, was slower than desired. HPFTP (high pressure fuel turbopump) and HPOTP (high pressure oxidizer turbopump) temperatures appeared to be very close to predictions. There were no anomalies identified.

MAIN PROPULSION SYSTEM

Overall performance of the MPS (Main Propulsion System) was excellent, both during prelaunch operations and the abort. LO2 and LH2 loading was accomplished as planned with no stop flows or reverts. Propellant loads were near the predicted values. There were no hazardous gas leaks of any significance.

The engine start buildups and transitions to mainstage were within specifications. Engine operation and performance during mainstage appeared satisfactory. During steady state performance, ET/ORB pressures and temperatures and ORB/SSME pressures and ratio and thrust values from the flight indicate repeatable engine performance. Power level throttling operation appeared normal. Engine shutdown was satisfactory. MECO occurred approximately 0.3 second earlier than predicted.

ORBITER

CRT-2 Went Blank

At approximately 243:16:24 G.m.t, the crew reported that CRT-2 went blank. The DU (display unit) and DEU (display electronics unit) BITE flags were on, and the DU filament current error, DU power supply error, and DU deflection error BITE bits were set. No current spikes at the time of the failure are discernible within the granularity of the data.

Engineering analysis almost conclusively indicated that the failure was in the DU, and that there was no mechanism by which a bad DEU could harm a replacement DU. An inflight maintenance procedure, which required about 1 hour 15 minutes, was performed to replace DU-2 with DU-4. The new DU operated normally.

Supply/Waste Water Nozzle Iced

During the third supply water dump, which included 80 percent from tank B and 20 percent from tank A, the supply water nozzle temperature decreased from 200° F to 38° F, recovered to 80° F, then peaked to 100° F and returned again to 80° F over a 19-minute period. Nozzle temperatures that drop below 50° F are indicative of ice formation. Use of the RMS CCTV (closed circuit television) verified that ice had formed around the supply water dump nozzle. The ice formation was approximately 12 in. in diameter and tapered to a point about 27 in. in length from the side of the vehicle.

Due to the ice formation, all subsequent supply water dumps were deleted from the STS 41-D mission timeline and the flash evaporator system was used to manage that water. A waste water dump was required and attempted on flight day 4 during live RMS CCTV coverage. The waste water dump was discontinued after expelling about 5 - 7 percent because of rapid ice buildup on the waste water nozzle. During the remainder of the mission, the crew used available bags for urine collection. Adequate waste water tank capacity existed for condensate collection.

A procedure was developed and successfully implemented to remove the ice from the supply water nozzle using the RMS to impact and dislodge the ice formation. Due to the proximity of the waste water nozzle to the wing, the waste water ice removal with the RMS was not attempted. Positioning the vehicle for side sun and repeated heater cycling resulted in the waste water ice being almost completely removed by flight day 7.

The formation of ice during the third supply water dump resulted from ice particles being trapped by the AFRSI/nozzle configuration and a large system pressure drop which caused the water dump spray pattern to widen and come in contact with the ice particles. Ice growth emanated from the ice particles back to the supply water nozzle completely covering the nozzle.

Oxygen Leak

A cryogenic oxygen leak occurred downstream of the ECS (environmental control system) supply isolation valve 2 on flight day 6. The leak was about 30 pound/hour in excess of the normal usage. The leak was isolated and stopped by closing ECS supply isolation valve 2.

Fuel Cell 1 Performance Monitor Indicator Failed

At approximately 243:18:35 G.m.t., the three cell-1-substack differential voltage measurements from the performance monitor read zero. There was no indication of power problems on any other equipment at that time indicating that the failure was in the monitor and not the fuel cell. Buses A and B were tied together to permit monitoring of fuel cell 1 performance by comparison of its load sharing with fuel cell 2. The buses were untied prior to entry.

Microswitch Anomalies

Five anomalies occurred on STS 41-D in which the electrical circuits contained microswitches of the same part number. These switch components are of the type that had previously experienced failures because of contamination. Conductive and non-conductive particles that are internal to the switches have caused both false "open" and false "closed" indications.

The five circuits that were involved include:

- a. The forward RCS (reaction control system) manifold 2 fuel isolation valve closed indication.
- b. The aft right RCS fuel 3/4/5 crossfeed valve open indication.
- c. The aft starboard payload bay door open indication.
- d. The right OMS (orbital maneuvering system) crossfeed B fuel and oxidizer valves open and closed indications.
- e. The right OMS fuel tank isolation valve open indication.

These problems had no impact on mission operations.

Vehicle Pulled To Right After Nose Gear Touchdown

The STS 41-D Commander reported during technical debriefings that the vehicle pulled to the right after nose gear touchdown. The Commander was able to control the vehicle satisfactorily by applying as much as 25 degrees of rudder. After the vehicle reached about 120 knots, the Commander began differential braking. A postflight inspection showed the right main gear shock strut was compressed to within 0.5 in. of the fully compressed condition; whereas, the left main gear was compressed to a nominal 3.5 in. The Schrader valve was found leaking gaseous nitrogen, which in turn decreased the pneumatic pressure and caused the excessively compressed strut. This low strut was responsible for the pulling-to-the-right condition noted during rollout.

PAYLOADS AND EXPERIMENTS

SBS-D SATELLITE

The SBS-D satellite was deployed at 243:20:40:18 G.m.t., within 1 second of the planned time. The deployment was nominal in all respects and the closed-circuit TV was used to monitor the deployment activities. The RMS television wrist camera was used to document the perigee kick motor firing. The SBS-D satellite has completed all major maneuvers and is now in geosynchronous orbit. The antennas and solar panels are deployed and the checkout has been initiated. All aspects of the Orbiter operation for this deployment were normal.

SYNCOM IV SATELLITE

The SYNCOM IV satellite was deployed at 244:13:16:27 G.m.t. within 1 second of the planned time. This SYNCOM satellite was the first that was specifically designed to fly on the Space Transportation System. Also, the deployment technique, named "frisbee deploy", was different from that used on previous satellites. The RMS TV was again used to monitor the successful perigee motor firing. All major planned maneuvers were successfully completed and the satellite is on station at 105 degrees west longitude. The UHF antennas are deployed and checkout of the satellite is in progress. All aspects of the Orbiter operation for this deployment were normal.

TELSTAR 3-C SATELLITE

The TELSTAR 3-C satellite was deployed at 245:13:25:52 G.m.t., again within 1 second of the planned time. The satellite is now in geosynchronous orbit with all major maneuvers completed. The satellite is in good health with all antennas and solar panels deployed, and the initial checkout has begun. All Orbiter systems operations in conjunction with the deployment were normal.

SOLAR ARRAY EXPERIMENT

The OAST-1 (Office of Aeronautics and Space Technology-1) solar array experiment performance was excellent with tests from the shopping list being completed in addition to the planned tests. The solar array extensions and retractions to both 70-percent and 100-percent were successful. The dynamics test at 70-percent and 100-percent extension provided good data and indicated that the deflections were less than expected due to the damping characteristics of the array. The dynamic augmentation tests at both extension positions were also successful. The solar cell calibration facility testing was satisfactorily completed. Also, on the final day of array operations, four dynamic tests at 70-percent extension and 150-percent of the excitation pulse used previously were successfully completed.

CONTINUOUS FLOW ELECTROPHORESIS SYSTEM

The CFES operations were satisfactory; however, only 85-percent of the samples were processed. The CFES shut down during the crew's first sleep period, but sample operations were successfully restarted on day 2. In addition, the CFES had two instrumentation failures, and two faulty carrier degassers (one was replaced using inflight maintenance procedures and the second was replaced by a plumbing change which moved the degasser on the anode side functionally to the cathode side). Also, operations during the change to the 10.2-psia cabin pressure on day 5 caused a shut-down. These problems resulted in the less than 100-percent completion of sample processing. Orbiter system operations, other than the change in cabin pressure, were normal and had no impact on CFES operations.

IMAX 70MM CAMERA

The IMAX camera and voice recorder were used to document operations with the OAST solar array experiment, and photograph crew and payload bay activities. A total of two magazines and six rolls of film were exposed during the mission. The camera jammed during photography of the SYNCOM IV deployment activities, but the crew was able to clear the jam and continue using the camera for the remainder of the mission. One of the floodlights failed during in-cabin photography. The resulting photography, based on reduced lighting, was grainier than expected, but was acceptable.

RADIATION MONITORING EQUIPMENT

The hand-held radiation monitor and the pocket RME (radiation monitoring equipment) meter were operated as planned during the mission. The hand-held device was operated four times and the pocket device was operated for two periods as planned.

CLOUD PHOTOGRAPHY

The cloud photography equipment operations were nominal. Over 450 photographs of excellent quality were taken of clouds.

STUDENT EXPERIMENT

The student experiment, Indium Crystal Growth, operations were less than desired because of a power and display problem. This problem caused early terminations of data collection activities, resulting in only 2 hours operation out of the 6 hours planned. The crew provided live CCTV coverage and an excellent narration of experiment activities.

TABLE II.- MSFC STS 41-D ANOMALY LIST

MSFC STS-41D ANOMALY LIST				DATE: SEPTEMBER 27, 1984	
NO.	TITLE	TIME, G.M.T	COMMENTS	RESP. MGR.	
1.	VIBRATION DATA DROPOUT	1243:12:45	THE VIBRATION DATA HAS A DROPOUT BETWEEN TO + 260-270 SECONDS. AN ADDITIONAL COPY OF THE MADS RECORDER TAPE HAS BEEN OBTAINED WITH NO DATA	SMME R. BLEDSOE EE21	
2.	SPIKES IN ME-2 PRESSURE DATA	POST FLIGHT EVALUATION	ALL CHANNEL A ME-2 (ENGINE 2018) PRESSURE MEASUREMENTS CONTAINED DATA SPIKES. CONTROLLER HAS BEEN SENT TO THE VENDOR FOR FAILURE ANALYSIS. CHALLENGER CONTROLLER DATA HAVE BEEN ANALYZED WITH NO SPIKES OBSERVED. CONTROLLER ON ENGINE 2018 (UNIT F-4) WILL BE REPLACED WITH UNIT F-9 PRIOR TO THE NEXT FLIGHT OF THIS ENGINE.	SMME R. BLEDSOE EE21	

TABLE III.- JSC OV-103 STS 41-D PROBLEM TRACKING LIST

JSC OV-103 STS 41-D PROBLEM TRACKING LIST				SEPT 26, 1984	
NO.	TITLE	TIME, G.M.T.	COMMENTS	RESP. MGR.	
JUNE 25 AND 26, 1984					
FIRST TWO LAUNCH ATTEMPTS					
1	FES DUCT HEATERS IN SYSTEMS A AND B FAILED.	PRELAUNCH 177:09:30(A) 177:10:10(B)	2 OF 4 HEATERS IN SYSTEM A FAILED (V63T1802A AND 1810A). 1 OF 4 HEATERS IN SYSTEM B FAILED (V63T1800A). TURNED ON BOTH SYSTEMS A AND B. TEMPERATURES STABILIZED. REPAIRED ZONE E HEATER FOR STS 41-D. REPAIR ZONE F AND H HEATERS AFTER STS 41-D OR AS SCHEDULE PERMITS.	L. TREVINO CAK AC8418F CLOSED 08/15/84	
2	GPC 5 (BFS) FAILED.	PRELAUNCH 177:12:06	FAILED BITE DUE TO 2 NON SEQUENTIAL PARITY ERRORS. REPORTED IOP FAILURE ATTEMPTING TRANSITION TO OPS 1. FOUND HARD FAILURE OF BIT 13 ON MEMORY PAGE A2 IN IOP. REMOVED AND REPLACED GPC FOR STS 41-D. CONTAMINATION IN IC CHIP. CAK AC8304F.	P. SOLLOCK CLOSED 08/08/84	
3	INSTRUMENTATION FAILURES: (PRELAUNCH)			CLOSED 08/08/84	
A	L RCS FUEL MANIFOLD PRESSURE 1 (V42P2312C) ERRATIC.	PRELAUNCH T-1 DAY	WENT UP TO 740 PSI THEN BACK TO 280 PSI. LAUNCH COMMIT CRITERIA REDUCED TO 2 OF 4 WITH PRESSURE 4 (V42P2318C) ALSO FAILED. NO 1 WORKED IN FLIGHT BUT 4 DID NOT. REPAIR TO 4 AFTER STS 41-D ISOLATED TO CARD ON MDN.	D. BLEVINS C. HOHNANN	
B	ET LH2 ULLAGE PRESSURE 2 (T41P1701C) LOW.	PRELAUNCH 177:14:39	SWITCHED TO SENSOR 4 (T41P1703C). SWITCHED BACK TO SENSOR 2 FOR SECOND PROPELLANT LOADING ABOUT 178:04:30. READ LOW INSTEAD OF AMBIENT BUT READ NORMAL WHEN ET WAS PRESSURIZED. SENSOR REPLACED FOR STS 41-D. WORKED IN FLIGHT.	D. PREVETT CAK AC8354F	
C	SSNE 2 H2 RECIRCULATION PUMP SPEED (V41R1215A) FAILED.	PRELAUNCH 177:05:30 178:05:30	SENSOR FAILED TO RESPOND WHEN PUMP WAS TURNED ON. AFTER STS 41-D, FOUND OPEN IN PUMP ON RECIRC SIDE. FLY AS IS. REPAIR AS SCHEDULE PERMITS.	P. COTA CAK AC8374F	

TABLE III.- JSC OV-103 STS 41-D PROBLEM TRACKING LIST (Continued)

JSC OV-103 STS 41-D PROBLEM TRACKING LIST				SEPT 28, 1984	
NO.	TITLE	TIME, G.N.T.	COMMENTS		RESP. EGR.
1	APU 3 LUBE OIL OUTLET PRESSURE (V46P0353A) BIASED LOW.	PRELAUNCH FROM FRF	PRESSURE READ ABOUT 6 PSI LOW BUT MEASUREMENT WAS USABLE. TRANSDUCER REMOVED AND REPLACED FOR STS 41-D. WORKED IN FLIGHT.	W. SCOTT	CAR AC834FF
4	O2 SYSTEM 1 SUPPLY VALVE TALKBACK FAILED CLOSED.	PRELAUNCH 178:04	CREW REPORTED ONBOARD PANEL L2 TALKBACK INDICATED CLOSED WHEN VALVE WAS VERIFIED OPEN. REPAIR AFTER STS 41-D OR AS SCHEDULE PERMITS. WORKED INTERMITTENT IN FLIGHT.	T. DAVIES	CLOSED 08/08/84
5	SSME 3 SERVO ACTUATOR MISCORPARE ON MAIN FUEL VALVE CHANNEL A.	PRELAUNCH 178:12:43	MISCORPARE BEFORE START OF SSME 1 RESULTED IN ABORT SHUTDOWN ABOUT 4 SECONDS BEFORE LAUNCH. NO ORBITER CORRECTIVE ACTION REQUIRED.	P. COTA	CLOSED 08/15/84
6	WATER AND FIRE DAMAGE AFTER PRELAUNCH SSME ABORT SHUTDOWN.	POST ABORT 178:15:00	FOUND WATER IN FES TOPPING DUCTS AND WSB DUCTS. SSME HEATSHIELD EYELID INSULATION BLANKETS WET. OUTER FABRIC OF AFRSI BLANKETS ON AFT FUSELAGE NOT WATERPROOF. SUSPECT +X RCS JET INSULATION WET. RTV ON RIGHT AFT OF VEHICLE DISCOLORED OR CHARRED. FIRE DAMAGE TO BODY FLAP RTV, SEVERAL FRSI PLUGS AND T-O UNBILICAL WIRE. DAMAGE WAS MINIMAL. DRYING AND TPS REFURB DONE AT PAD.	R. L. JOHNSTON J. SMITH	CLOSED 08/15/84
7	HYDRAULIC SYSTEM 3 PUMP LEAKED.	POST ABORT GROUND INSPECTION	LOST ABOUT 1X OF RESERVOIR. LEAK FOUND AT OUTLET ROSAN FITTING. R&R PUMP AND LINE FOR STS 41-D. DEFECT IN O-RING MANUFACTURE.	D. HAINES	CAR AC8341F CLOSED 08/01/84

PREPARED BY: /s/RJW
ROBERT J. WARD

09/28/84
DATE

APPROVED BY: /s/JEM
JOSEPH E. NECHELAY

09/28/84
DATE

TABLE III.- JSC OV-103 STS 41-D PROBLEM TRACKING LIST (Continued)

JSC OV-103 STS 41-B PROBLEM TRACKING LIST					SEPT 28, 1984	
NO.	TITLE	TIME, G.M.T.	COMMENTS	RESP. MGR.		
LAUNCH AUGUST 30, 1984 243:12:41:50 G.M.T.						
8	L OMS FUEL TOTAL QUANTITY GAGE FAILED.	243:12:52:40	READING DROPPED TO 45.6% DURING OMS-1 AND REMAINED THERE. SHOULD HAVE BEEN ABOUT 69% AFTER BURN. T/S DID NOT ISOLATE. REPLACED TOTALIZER FOR OX GAGING PROBLEM.	C. HUMPHRIES CAR 14F005 CLOSED 09/27/84		
9	INSTRUMENTATION FAILURES:			CLOSURE IN PROCESS		
A	SSME 3 GH2 OUTLET TEMPERATURE (V41TI361A) FAILED.	243:12:42:40	READ OFF SCALE HIGH. NDR. R&R. REPLACED WITH NEW HI VIBRATION DESIGN.	D. PREVETT CAR 14F001		
B	SSME 3 LH2 INLET PRESSURE (V41PI300C) READ LOW.	243:12:43:20	READ 25 PSIA. SHOULD HAVE BEEN ABOUT 36 PSIA. INSPECTED PER CHIT. CHECKED CAL CURVE. FLY AS IS.	D. PREVETT DR 14F002		
C	SSME 1 LH2 INLET PRESSURE (V41PI100C) FAILED.	243:12:41:59	READ OFF SCALE HIGH ABOUT 9 SECONDS AFTER LAUNCH. NDR. R&R.	D. PREVETT CAR 14F003		
D	APU 1 EXHAUST GAS TEMPERATURE 2 (V46TO140A) ERRATIC.	249:13:25	READING ERRATIC AT WEST COAST AOS. MDR. R&R. REQUIRED FOR LAUNCH COMMIT CRITERIA.	W. SCOTT CAR 14F011		
10	CRT 2 WENT BLANK.	243:16:24	CREW IN FLIGHT REPORT. R&R. CAPACITOR FAILED IN LOW VOLTAGE POWER SUPPLY. CRT 2 MAX TEMP HIGH. FLOW RATE PER SPEC.	G. RAINES CAR 14F004 CLOSED 09/27/84		
11	S-BAND QUAD ANTENNA SWITCH MISCOMPARE.	243:14:17:49	OCCURRED 4 TIMES. DEU EQUIVALENT UPLINKED TO INHIBIT FDA'S. SUSPECT ANTENNA SWITCH S1 MECHANICAL MALFUNCTION AND UPPER LEFT FORWARD BEAM SWITCH TATTLETALE. R&R.	O. SCHMIDT CAR 14F008 CAR 14F021 CLOSURE IN PROCESS		

TABLE III.- JSC OV-103 STS 41-D PROBLEM TRACKING LIST (Continued)

JSC OV-103 STS 41-D PROBLEM TRACKING LIST				SEPT 28, 1984
NO.	TITLE	TIME, G.M.T.	COMMENTS	RESP. MGR.
12	FUEL CELL 1 PERFORMANCE MONITOR INDICATED FAILED. (V45P102A, V45P103A, AND V45P104A).	243:19:05	BUS TIED A TO B TO PERMIT MONITORING BETWEEN FC-1 AND FC-2 DURING ON-ORBIT OPERATIONS. R&R MONITOR. SUSPECT MONITOR INTERNAL POWER SUPPLY.	T. DAVIES CAR 14F007 CLOSED 09/27/84
13	FORWARD RCS MANIFOLD 2 FUEL ISOLATION VALVE CLOSE INDICATION FAILED (V42X1327X).	245:03:50	VALVE SWITCHED TO GPC POSITION TO REMOVE POWER FROM THE VALVE. CLOSE IND WORKED JUST BEFORE LANDING. T/S COULD NOT REPEAT. FLY AS IS. SUSPECT TRANSIENT CONTAMINATION.	C. HOHMANN CAR 14F009 CLOSURE IN PROCESS
14	SUPPLY WATER & WASTE WATER NOZZLES ICED.	246:09:24	POST DUMP TEMPERATURES INDICATED WASTE NOZZLE ICE. CLEARED BUT ICE REMAINED ON SUPPLY NOZZLE. TV INSPECTION OF NOZZLES CONFIRMED ICE. THE WASTE DUMP WAS STOPPED WHEN ICE FORMED. RMS USED TO DISLODGE ICE FROM SUPPLY NOZZLE. REMAINING ICE ON WASTE NOZZLE NO HAZARD. USED BAGS FOR WASTE WATER. KSC CONFIRMED CONFIGURATION.	H. ROTTEK CLOSURE IN PROCESS
15	KU-BAND ANTENNA UNDAMPED OSCILLATION.	244:23:10	ANTENNA HIT BOTH AXIS DRIVE STOPS AT SAME TIME IN HIGH RATE SEARCH MODE. CREW STOPPED OSCILLATION BY GOING TO "OFF". DELETED GPC HIGH SPEED SCANS FOR CABLE POSITIONING. STOPS INSPECTED OK.	O. SCHMIDT CAR 14F006 CLOSED 09/27/84
16	HYDRAULIC SYSTEM 1 UNLOADER VALVE MALFUNCTIONED.	245:22:09:40	CIRC PUMP INCREASED ACCUMULATOR PRESSURE (V58P0167A) TO 2978 PSIA EXCEEDING MAX RELIEF SETTING OF 2560 PSIA. R&R UNLOADER VALVE. PROBABLE CONTAMINATION.	D. HAINES CAR 14F016 CLOSED 09/27/84
17	HYDRAULIC SYSTEM 3 BOOT STRAP PRESSURE DROP.	247:08:41	DROPPED TO 1860 PSIA. SHOULD HAVE STAYED ABOVE 2050 PSIA. CIRC PUMP MAINTAINED PRESSURE (V58P0367A). R&R UNLOADER VALVE. PROBABLE CONTAMINATION.	D. HAINES CAR 14F017 CLOSED 09/27/84

TABLE III.- JSC OV-103 STS 41-D PROBLEM TRACKING LIST (Continued)

JSC OV-103 STS 41-D PROBLEM TRACKING LIST				SEPT 28, 1984	
NO.	TITLE	TIME, G.M.T.	CONTENTS	RESP. MGR.	
18	AFT RIGHT RCS FUEL 3/4/5 CROSSFEED VALVE DID NOT INDICATE OPEN. (V42X3338X).	248:08:41	SWITCHED TO GPC POSITION TO REMOVE POWER FROM VALVE. T/S AT KSC. R&R AC MOTOR ACTUATOR.	C. HODMAN CAR 14F010 CLOSURE IN PROCESS	
19	PHOTO FLOODLIGHT FAILED.	246:21:14:30	INAX FILMING IMPACTED. CREW SAID FOOD WARMER CIRCUIT WAS USED. RELOCATED REMAINING INAX LIGHT. USED REVISED PROCEDURES FOR MIDDECK FILMING. R&R AT DRYDEN. FUSE BLOWN IN LIGHT.	D. GERNANY FIAR CLOSED 09/27/84	
20	LANDING GEAR ISOLATION VALVE 2 INDICATED OPEN.	248:11:42:15	DURING FCS CHECKOUT, VALVE INDICATED OPEN ABOUT 30 SECONDS AFTER APU START. SLOW VALVE RESPONSE RIGHT AFTER CIRC PUMP START.	D. HAINES CLOSED 09/27/84	
21	RIGHT OMS OXIDIZER LOW POINT DRAIN-LINE HEATER B THERMOSTAT FAILED. (V43T6237)	248:20:52:54	DROPPED TO 48 DEG F. SWITCHED TO SYSTEM A. IPR. ISOLATED BY T/S AT KSC. R&R THERMOSTAT. SUSPECT CONTACT CONTAMINATION.	C. HUMPHRIES CAR 14F013 CLOSED 09/27/84	
22	OXYGEN LEAK DOWNSTREAM OF ECS SUPPLY VALVE 2.	248:22:12	LEAK PROBABLY UPSTREAM OF FLOW RESTRICTOR. T/S AT KSC. IPR. FOUND CRIFICE IN BACKWARDS. LOW CRYO TEMP DURING CABIN REPRESS OPENED FLANGE SEAL.	N. PRINCE T. DAVIES CLOSURE IN PROCESS	
23	AFT STARBOARD PAYLOAD BAY DOOR OPEN MICROSCHITCH (V37X3301) STAYED ON AND STARBOARD DRIVE MOTOR 2 RAN THROUGH HALF OF LATCH CYCLE.	249:09:35	OPEN INDICATION REMAINED DURING AND AFTER STARBOARD PLEE CLOSURE. ALL PLEE CLOSED AND LATCHED INDICATIONS WERE RECEIVED. OPEN IND WENT OFF AT LANDING. CLOSE IND (V37X3303) TRIPPED ABOUT 13 SECONDS INTO AFT STED BULKHEAD LATCH CYCLE. R&R ACTUATOR. RERIGGED.	R. BALCIUKAS CAR 14F012 CLOSURE IN PROCESS	
24	RIGHT OMS CROSSFEED B FUEL AND OXIDIZER VALVES CLOSED INDICATIONS FAILED. (V43X5239X, 5359X)	249:12:24:10	ONBOARD VALVE POSITIONS SHOWED CLOSED. T/S AT KSC SHOWED BOTH FU & ON CLOSED DISCRETES FAILED. FLY AS IS UNTIL ACCESSIBLE. SUSPECT FAULTY LIMIT SWITCHES.	C. HUMPHRIES CAR 14F014 CLOSED 09/27/84	

TABLE III.- JSC OV-103 STS 41-D PROBLEM TRACKING LIST (Concluded)

JSC OV-103 STS 41-D PROBLEM TRACKING LIST				SEPT 28, 1984	
NO.	TITLE	TIME, G.M.T.	COMMENTS	RESP. MGR.	
25	RIGHT OMS FUEL TANK ISOLATION VALVE A OPEN INDICATION FAILED.	249:13:07	CREW MOVED SWITCH TO GPC POST LANDING TO REMOVE POWER FROM VALVE. T/S AT KSC. DID NOT REPEAT. FLY AS IS UNTIL ACCESSIBLE. SUSPECT LIMIT SWITCH CONTAMINATION.	C. HUPPINKES CAR 14F015 CLOSED 09/27/84	
26	VEHICLE PULLED TO RIGHT AFTER NOSE GEAR TOUCHDOWN.	LANDING 249:13:37	POST LANDING CREW REPORT. RIGHT MAIN GEAR STRUT LOW. PROBABLY BOTTOMED OUT. FOUND G2 LEAK IN SCHRAEDER VALVE. R&R VALVE AND STRUT. NO VISIBLE DAMAGE TO STRUT. VALVE SWIVAL NUT OVER TORQUED.	J. McCULLOUGH CAR 14F018 CLOSURE IN PROCESS	
27	OSCILLATING LINEAR ACCELERATION DURING LIGHT BRAKING.	LANDING 249:13:37	POST LANDING CREW REPORT. FOUND A BROKEN RETAINER WASHER ON RH OUTBD BRAKE. SIX WASHERS WERE BROKEN, AND 6 ROTOR CLIP TAILS BENT ON LH INBD BRAKE. FELT LIKE A REAL SLOW ANTI SKID SLIDING OVER PATCHES OF ICE. REACHED ONLY 6 FPS DECEL INSTEAD OF 8. BRAKE DAMAGE MINIMAL. SUSPECT OSCIL FROM LOW SHOCK STRUT.	C. CAMPBELL CAR 14F019 CAR 14F020 CLOSURE IN PROCESS	
28	RIGHT INBOARD ELEVON SECONDARY DELTA P CHANNEL 4 HIGH.	PRELAUNCH	AFTER APU'S REACHED FULL PRESSURE, CH 4 WAS HIGH FOR ABOUT 23 SECONDS. CLEARED BEFORE PRELAUNCH PROFILE TEST. SUSPECT TRANSIENT CONTAMINATION. STANDARD RESERVOIR FLUID SAMPLES. FLY AS IS.	J. VERNON CLOSED 09/27/84	
29	FORWARD ORBIT DAP PANEL (C3) ROTATION PULSE PITCH FBI LIGHT INTERMITTENT.	246:14:00	CREW REPORTED LIGHT TESTED BOTH GOOD AND BAD. DID NOT CHANGE SINCE IT WAS WORKING. T/S ISOLATED TO SWITCH/LIGHT ASSEMBLY. R&R.	R. BURGHEUFF CAR 14F024 CLOSED 09/27/84	
30	COLOR TV CAMERA ON RMS ELBOW SHOWED A HORIZONTAL LINE.	IN FLIGHT	CREW CONFIRMED LINE SEEN WHEN SET UP FOR A DARK SIDE PASS. LINE APPEARED AFTER VIEWING SUN FOR ABOUT 1.5 MINUTES. R&R.	O. SCHMIDT B. EMBREY FIAR	

JSC-2006 SFS 41-B Mission Report Distribution:

NASA Headquarters

LB-4/E. L. Roth
LB-4/S. S. Webster
MPI-5/H. Rosen (2)
MPI-5/N. Masby
NH-3/N. A. Schulze (6)
NHB-8/N. Franden
NHB/N. Boser

Goddard Space Flight Center

400/N. Kaathley
400/R. L. Baumann
420/N. Eiband (10)
700/J. R. Boeckle
710/T. E. Huber
730/E. J. Powers
731/E. M. Travis
731/J. P. Young
740/J. Barron (6)
300/A. E. Jones
302/N. F. Bangs
302/N. B. Keegan
313/N. Harriott

KSC

MSI-D/Repository (35)

MSFC

MS20/Repository (30)
EL61/S. Richards (5)
EL63/P. Hoag (5)
FAS1/P. R. Reinartz
JA01/J. A. Downey
SA25/O. E. Hannon

Langley Research Center

Technical Library/Mail Stop 185

Rockwell-Dallas

FA89/R. M. Hize (130)

Rockwell-Houston

ZC01/B. Stein (5)
ZC01/R. Filler
ZC01/M. E. Smith

JSC

AL/C. S. Hutton
AE/A. Cohen
AN/C. E. Charlesworth
AN/L. C. Dunselth
AP3/D. Affer (4)
AP4/N. Kersman
BE4/History Office (2)
BR/D. A. Mebrig
CA/B. W. S. Abbey
CA/N. J. North
CB/J. V. Young (5)
CB/R. L. Crippen (7)
DA/E. F. Krantz
DA6/R. Legler
DA6/T. R. Low
DR6/C. Lewis
DF/D. F. Puddy
DR/R. K. Holkan
DH3/J. W. O'Neill (2)
DH3/C. F. Dettlerich
DAA/D. A. Bland
DHA/E. S. Pippert
DMA/J. F. Whitely
EA/T. Mader
EC/N. M. Ray
EC2/D. F. Hughes
EC3/P. R. Samonski (2)
EC4/L. B. Casey
EE/R. S. Sawyer
EE/J. N. Johnson
EE2/D. L. Knight
EE6/W. E. Zrubek
EE7/D. L. Schmidt
EE7/C. J. Stoker
EEB/J. Porter (2)
EF/R. M. Kuttan
EFS/K. I. Mansfield
EW/H. E. Smith
EN/K. J. Cox

EH13/R. E. Lewis
EH13/S. Murray (2)
EN2/P. C. Kramer
EH3/N. B. Holley
EH4/E. S. Chevalier
EH6/R. E. Wilson
EH5/D. H. Shelton
EH5/J. E. Yeo
EH3/A. D. Harris (4)
EP/H. J. Brasseaux
EP2/C. R. Gibson

EP4/L. Jenkins
EP5/W. A. Chandler
EP6/C. A. Vaughn
ES/D. C. Wade
ES/D. M. Greenshield
ES/P. C. Glynn
ES12/N. G. McMullen (2)
ES3/J. A. Smith
ES3/L. D. Palmer (2)
ES3/M. Strouhal
ES6/R. L. Johnston
ET/B. G. Jackson
ET/R. Barton
ET/P. E. Thomas
ET3/L. D. Hayman
ET5/R. Balclunas
ET5/M. K. Cressy
ET5/M. J. Jones (2)
FA/J. C. Bostick
FA/R. E. Ernell
FD/J. R. Barman
FD/S. M. Keathley
FD/C. F. McLoone
FD6/R. N. Regelbrugge
FD6/S. Morris
FE/P. M. Barnes

FM/E. C. Lineberry, Jr. (6)
FM2/S. Mayfield
FM2/R. Nelson
FM2/C. Wells (2)
FM5/J. C. Harpold
FM51/E. R. Schiffer
FR/E. M. McHenry
FR/L. D. Dungan
FS/J. E. Mager (2)
FS12/R. J. Allen
FS2/J. A. Smith
JMS/Library (3)
LA/O. S. Lumley
LA/R. M. Kohrs
LA2/E. M. Jones
LA33/M. Winchester
LA8/E. Honeycutt
LA6/L. S. Nicholson
LA6/L. G. Williams
LA6/R. L. Mount
LA62/R. V. Battley (5)
LF/B. C. Schmitt
LE/N. H. Douglas
LH/B. K. Mielke
LH/A. A. Bishop
LM/J. Bates
LM/L. Kayser
LM/L. E. Bell
LM/A. Joslyn
LP/N. A. Moke (5)
LT/J. F. Gores
NA/J. D. Aldrich
NA/R. A. Colonne
NA/R. C. Hood
ND/M. N. Collins, Jr.
ND2/M. J. Baylor
ND2/R. M. Fricke (25)
ND2/B. Johnson
ND2/C. Crittzen
ND3/J. E. Machelay (3)
ND3/M. A. Ward
ND4/R. Bonheur
NE/R. E. Bobola
NE/R. H. Bradley
NE3/P. M. Deans
NE4/M. H. Taylor
NE5/M. F. Peak
NE5/M. C. Condy

NG/R. H. Moorhead
NH/J. Prasner
NP/C. McCullough (3)
NP12/M. Windler
NP2/S. M. Andrich
NR/M. S. Wilson
NA/M. L. Raines
NA/L. T. Spence
NB/J. H. Levine
ND/T. J. Adams
PS/L. S. Collins (20)
SA/J. T. Kerwin
SB/S. L. Pool
SE/M. H. Bush
SP/C. D. Parnar (5)
ZRI/Col. Gregory M. Risch
ZRI/D. L. Myche
ZRI2/B. Cobb

Hamilton Standard/EOFS

D. Schomer
Mr. Willis M. Hawkins
Senior Advisor
Lockheed Corporation
P. O. Box 551
Burbank, CA 91520

Dr. Richard M. Battin
Associate Department Head
Charles Stark Draper Laboratory, Inc.
555 Technology Square
Cambridge, MA 02139

LT. Gen. Leighton I. Davis
USAF (Ret.)
729 Stagecoach Road, Four Hills
Albuquerque, NM 87123

Mr. Herbert E. Grier
Consultant
2223 Avenida de la Playa
Suite 304
La Jolla, CA 92037-3294

Mr. Ira Grant Hedrick
Presidential Assistant for
Corporate Technology
Grumman Aerospace Corporation
Bethpage, NY 11714

Dr. Seymour C. Himmel
12700 Lake Avenue
#1501
Lakewood, OH 44107

Mr. John F. McDonald
Vice President-Technical Services
Tigerair, Inc.
3000 North Claybourn Avenue
Burbank, CA 91506

Dr. John D. Stewart
Manager, Office of Planning and
Budget
Tennessee Valley Authority
6609
400 Commerce Avenue
Knoxville, TN 37902

R. Birman
Room 10A23
General Electric Co.
Space Division
P. O. Box 8555
Philadelphia, PA 19101

TRM
Houston, TX 77058
Attn: C. Peterson/H5

R. Hoey
510 Test Wing/TEG/236
Edwards AFB, CA 93523

R. L. Hitchcock
2474 Seahorse Ave.
Ventura, CA 93001

D. McCurdy
Mail Stop 463
Langley Research Center
Hampton, VA 23561

Maj. F. Pitoniak/TVAI (5)
Headquarters, Space Division
Los Angeles, AF Station
P. O. Box 92960
Worldway Postal Center
Los Angeles, CA 90009

Dr. J. A. Hunter
National Aeronautical Establishment
National Research Council of Canada
Ottawa, Canada K1A 0R6

John Williams
1995 Ferndale Place
Thousand Oaks, CA 91360

Dr. K. H. Doetsch
National Aeronautical Establishment
National Research Council of Canada
Ottawa, Canada K1A 0R6

B. A. Aikenhead
National Aeronautical Establishment
National Research Council of Canada
Ottawa, Canada K1A 0R6

T. H. Ussher (2)
SPAR Aerospace Limited
1700 Drimost Dr.
Markham, Ontario, Canada M3L 2M7

J. Middleton
SPAR Aerospace Limited
825 Caledonia Road
Toronto, Ontario, Canada M6B 3X9

W. Permet
5907 Sunrise Drive
Fairway, Kansas 66206

R. Peterson
Mail Stop 818-5
Minneapolis - Honeywell
Avionics Division
13260 Hwy 19
Clearwater, FL 33546

C. Wiltsie (4)
Mail Stop 244-14
Code SP
Ames Research Center
Moffett Field, CA 94035

Hq. AFTEC
TESS/
Kirtland AFB, N. Mex. 87117

AFTEC/OL-6F (2)
Patrick AFB, FL 32925

Aerospace Corporation
P. O. Box 92957
Los Angeles, CA 90009
Attn: M. Smith, 125/1362
M. Portantier, H5/676

McDonnell Douglas-Houston
D2/N. D. Pipher

D. Holgaard
Mail Station 735-6661
TRM System
1 Space Park
Redondo Beach, CA 90278

A. J. Sava/Mail Code 83
H. Gucco/Mail Code 92
IBM Bldg.
1822 Space Park Drive
Houston, TX 77058

James R. Novack
JPL/233-307
4800 Oak Grove Drive
Pasadena, CA 91109

T. Myers
System Technology, Inc.
13766 So. Hawthorne Blvd.
Northridge, CA 90250

R. F. Wilson/Librarian
IBM Mail Code 92
1822 Space Park Drive
Houston, TX 77058

Dr. David Rose Grove
10 Rose Grove
Roman Bank
Skopness, Lincolnshire
England

Mr. Richard J. H. Barnes
NASA European Representative
c/o American Embassy
NASA Resident Management Office
Noordwijk
The Netherlands

Notify ND2/R. M. Fricke (FTJ-525-6353) of any corrections, additions, or deletions to this list.

